Poesen, J., Maetens W., Smets, T., Verachtert, E., Vanmaercke, M., Nyssen, J. 2010. Soil and water conservation: problems and research needs for improving predictions. Keynote paper presented at the Environment workshop 2010 on "Optimizing and integrating predictions of agricultural soil and water conservation models at different scales". Universidad Internacional de Andalucia, Baeza, Spain, 27-29 September 2010.

Soil and water conservation: problems and research needs for improving predictions.

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Soil and water conservation techniques (SWCT) are being applied worldwide to maintain or improve soil quality and to control the detrimental off site effects of soil erosion. Although successful in many regions, these SWCT have not always lead to the desired effects. This paper explores some of the reasons why by analyzing some case-studies. It also discusses research needs a) for a better understanding of the interactions between land degradation, land use and SWCT, b) for optimizing SWCT and c) for improving predictions of the effectiveness of SWCT.

Erosion processes. Before deciding on the application of SWC to agricultural land, water erosion assessments are made typically relying on the assessment of sheet and rill erosion rates using models (e.g. (R)USLE). Therefore most SWCT applied have often been designed for and applied at the parcel scale to control mainly sheet and rill erosion, with little or no attention for other soil erosion processes operating at the same time and interacting with sheet and rill erosion. Several case studies in different environments have clearly shown that other processes, such as ephemeral gully erosion, piping erosion, tillage erosion, soil erosion caused by (mainly root and tuber) crop harvesting, shallow landsliding or erosion by land levelling may be at least as significant as sheet and rill erosion, if not more important. Hence, designing SWCT focussing on sheet and rill erosion only may not always be very effective. Therefore a more comprehensive assessment of soil erosion processes and their interactions is needed before designing an effective soil and water conservation strategy addressing all important soil erosion processes, their interactions and their implications for hillslope hydrology.

Scale issues. Given that most SWCT address essentially sheet and rill erosion, their effectiveness has been mainly tested on small spatial units (small plots in the laboratory or runoff plots in the field). Although such experiments have resulted in valuable data, providing insight into the functioning of SWCT under various environmental conditions and providing input for soil erosion models, the effects of such SWCT on runoff and soil loss at larger spatial units (i.e. entire hillslope or (small) catchments) is still poorly understood. For instance, a recent review of plot data indicates that the effectiveness of a vegetation cover or a mulch cover in controlling runoff and soil losses by sheet and rill erosion increases with slope length. There is a need for better understanding of the impacts of various SWCT and their interactions at the catchment scale and one way forward is be the establishment of sediment budgets, indicating the type and magnitude of the various sediment sources and sinks and how these are affected by SWCT.

How effective are various SWC measures for controlling runoff and soil loss in a given environmental context? Although many plot experiments have been conducted to test

particular SWCT in different parts of the world (mainly for demonstration purposes) we still often rely on model predictions for assessing the effects of these SWCT on runoff and soil loss. A recent analysis of all available runoff plot data in Europe, for instance, revealed that particular SWCT may be less effective in a given environment compared to another. Such plot data should be used to improve model predictions.